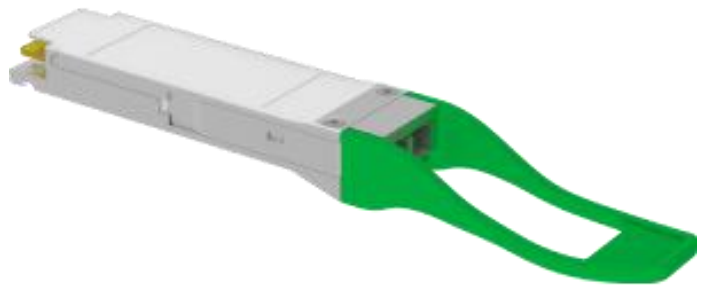
100G QSFP28 FR1 2km Optical Transceiver Module

FST-100G-FR

Features

- QSFP28 MSA compliant
- Compliant to 802.3cu
- 100G FR1 Specification compliant
- Maximum power consumption 4.5W
- LC connector
- Up to 2km transmission on single mode fiber with FEC
- Operating case temperature: 0℃~70℃
- Single 3.3V power supply
- RoHS-6 compliant

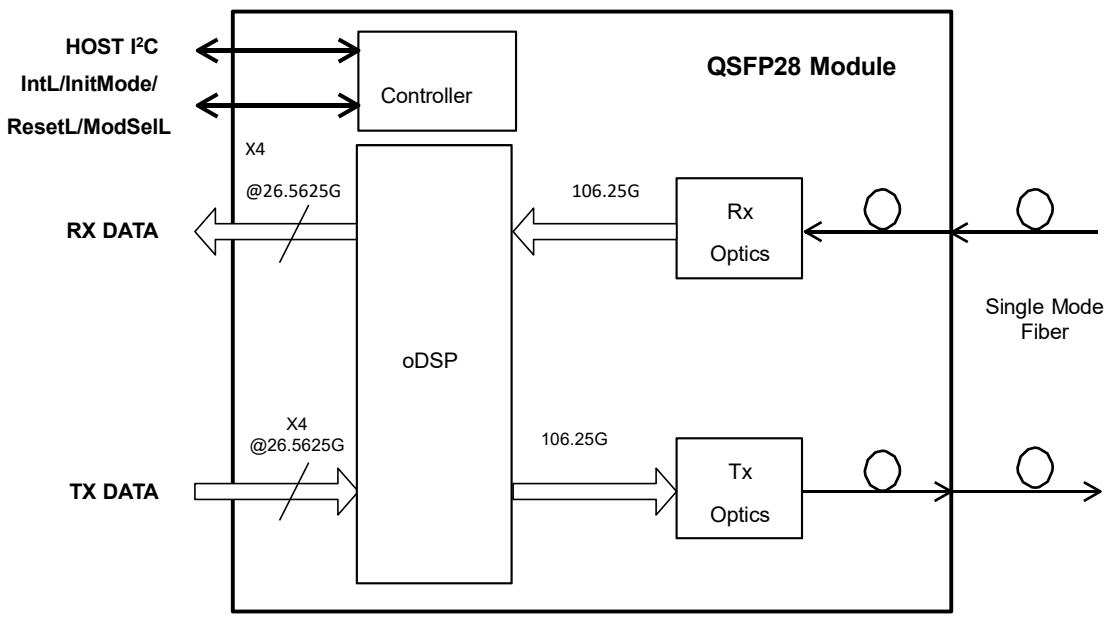


Applications

- 100G Ethernet
- Data Center Interconnect
- Enterprise networking

Description

FST-100G-FR is a transceiver module designed for 2km optical communication applications, and it is compliant to IEEE 802.3cu 100G FR1 MSA standard. This module can convert 4-channel 26.5625Gb/s electrical data to 1-channel 106.25Gb/s optical signals. Similarly, it can convert 1-channel 106.25Gb/s optical signals to 4-channel output electrical data on the receiver side. It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference. The module offers very high functionality and feature integration, accessible via a two-wire serial interface.



Transceiver Block Diagram

Figure 1. Transceiver Block Diagram

Proposed Application Schematics

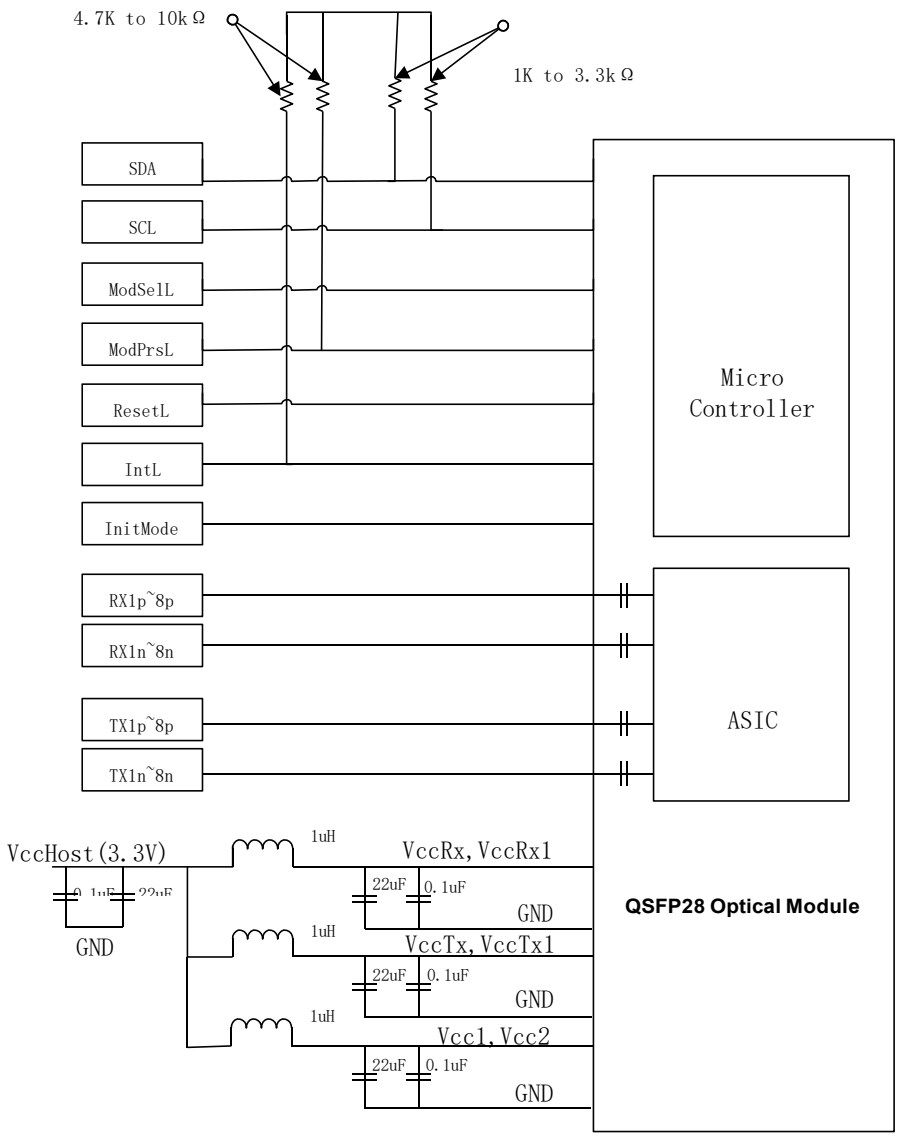


Figure 2. Proposed Application Schematics

Pin Descriptions

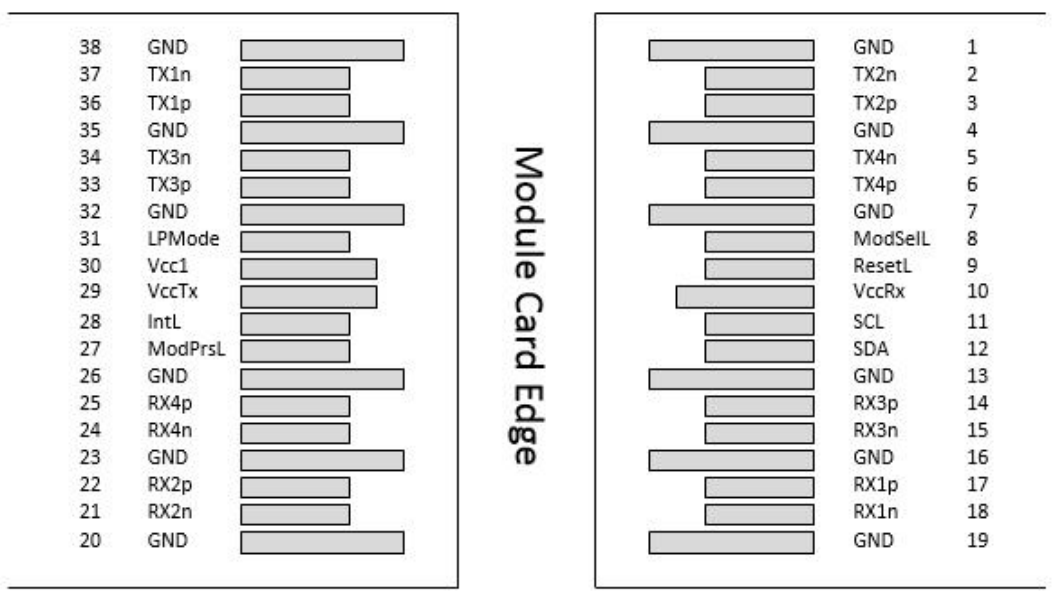


Figure 3. QSFP28 MSA compliant Connector

Pin	Symbol	Description	Notes
1	GND	Ground	1
2	Tx2n	Transmitter Inverted Data Input	
3	Tx2p	Transmitter Non-Inverted Data Input	
4	GND	Ground	1
5	Tx4n	Transmitter Inverted Data Input	
6	Tx4p	Transmitter Non-Inverted Data Input	

Pin	Symbol	Description	Notes
7	GND	Ground	1
8	ModSelL	Module Select	
9	ResetL	Module Reset	
10	Vcc Rx	+3.3V Power Supply Receiver	
11	SCL	2-wire serial interface clock	
12	SDA	2-wire serial interface data	
13	GND	Ground	1
14	Rx3p	Receiver Non-Inverted Data Output	
15	Rx3n	Receiver Inverted Data Output	
16	GND	Ground	1
17	Rx1p	Receiver Non-Inverted Data Output	
18	Rx1n	Receiver Inverted Data Output	
19	GND	Ground	1
20	GND	Ground	1
21	Rx2n	Receiver Inverted Data Output	
22	Rx2p	Receiver Non-Inverted Data Output	
23	GND	Ground	1
24	Rx4n	Receiver Non-Inverted Data Output	
25	Rx4p	Receiver Inverted Data Output	
26	GND	Ground	1
27	ModPrsL	Module Present	
28	IntL	Interrupt	
29	Vcc Tx	+3.3V Power supply transmitter	
30	Vcc1	+3.3V Power supply	
31	LPMode	Low Power Mode	
32	GND	Ground	1
33	Tx3p	Transmitter Non-Inverted Data Input	
34	Tx3n	Transmitter Inverted Data Input	
35	GND	Ground	1
36	Tx1p	Transmitter Non-Inverted Data Input	
37	Tx1n	Transmitter Inverted Data Input	
38	GND	Ground	1

Absolute Maximum Ratings

It has to be noted that the operation in excess of any individual absolute maximum ratings might cause permanent damage to this module.

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Maximum Supply Voltage	Vcc	-0.5	3.3	3.6	V	
Storage Temperature	Ts	-40		85	℃	
Relative Humidity	RH	0		85	%	1
Damage Threshold, each lane	THd	5.5			dBm	
Notes:1.Non-condensing						

Operating Environments

Electrical and optical characteristics below are defined under this operating environment, unless otherwise specified.

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	Vcc	3.135	3.3	3.465	V
Case Temperature	T	0		70	℃
Data Rate Accuracy		-100		100	ppm
Link Distance with G.652		2		2000	m

Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Note
Power dissipation	P			4.5	W	
Supply Current	Icc			1.435	A	
Transmitter						
Data Rate, each lane		26.5625±100ppm			GBd	
Differential input Voltage pk-pk	Vpp	900			mV	1
Common Mode Voltage	Vcm	-350		2850	mV	2
Differential Termination Resistance Mismatch				10	%	
Single-ended Voltage Tolerance Range (Min)		-0.4		3.3	V	
Differential Input ReturnLoss		IEEE 802.3-2015 Equation(83E-5)			dB	
Differential to Common Mode Input Return Loss		IEEE 802.3-2015 Equation(83E-6)			dB	
Module Stressed Input		IEEE 802.3cu				3
Test						
Receiver						
Data Rate, each lane		26.5625±100ppm			GBd	
Differential Termination Resistance Mismatch				10	%	

Parameter	Symbol	Min	Typ	Max	Unit	Note
Differential output Voltage pk-pk	Vpp			900	mV	
Common Mode Voltage	Vcm	-350		2850	mV	2
Common Mode Noise,RMS	Vrms			17.5	mV	
Transition time (min)		9.5			ps	20%to80%
Near-end Eye height,differential (min)		70			mV	
Near-end ESMW (Eyesymmetry mask width)		0.265			UI	
Far-end ESMW (Eye symmetry mask width)		0.2			UI	
Far-end Eye height, differential (min)		30			mV	
Far-end pre-cursor ISI ratio		-4.5		2.5	dB	
Differential output return loss		IEEE 802.3-2015 Equation (83E-2)				
Common to differential mode conversion return loss		IEEE 802.3-2015 Equation (83E-3)				
Note: 1. With the exception to IEEE 802.3cu that the pattern is PRBS31Q or scrambled idle. 2. DC common mode voltage generated by the host. Specification includes effects of ground offset voltage. 3. BER specified in IEEE 802.3 cu.						

Optical Characteristics

Parameters	Unit	min	type	max
Transmitter				
Data Rate	GBd	53.125±100ppm		
Modulation Format		PAM4		
Line wavelengths	nm	1304.5	1311	1317.5
Average Launch Power	dBm	-2.4		4
Optical Modulation Amplitude(OMA)	dBm	-0.2		4.2
Extinction Ratio (ER)	dB	3.5		
Side-Mode Suppression Ratio(SMSR)	dB	30		
Launch power in OMA minus TDECQ	dB	-1.6(ER≥4.5dB) -1.5(ER<4.5dB)		
Transmitter and Dispersion Eye Clouser for PAM4 (TDECQ)	dB			3.4
RIN15.5OMA	dB/Hz			-136
Optical Return Loss Tolerance	dB			15.5
Transmitter Reflectance	dB			-26
Average Launch Power of OFF Transmitter	dBm			-15
Receiver				
Data Rate	GBd	53.125±100ppm		
Modulation Format		PAM4		

Parameters	Unit	min	type	max
Damage Threshold	dBm	5.5		
Line wavelengths	nm	1304.5		1317.5
Average receiver power	dBm	-6.4		4.5
Receiver power (OMA)	dBm			4.7
Receiver Sensitivity (OMAouter) (max)	dBm			Max(-4.5,SECQ-5.9)
Stressed receiver Sensitivity (OMAouter) (max)	dBm			-2.5
LOS Assert	dBm	-13		
LOS Deassert	dBm			-8
LOS Hysteresis	dB	0.5		
Receiver reflectance	dB			-26
Conditions of Stressed Receiver Sensitivity				
Stressed eye closure for PAM4(SECQ), lane under test	dB			3.4
Note: Receiver sensitivity (OMAouter), each lane (max) is informative and is defined for a transmitter with SECQ of 0.9 dB Measured with conformance test signal for BER = 2.4x10-4. A compliant receiver shall have stressed receiver sensitivity (OMA outer), each lane values below the mask of Figure 3, for SECQ values between smaller than 3.4 dB.				

EEPROM Definitions

Lower Memory Map

Data address	Name	Description	Value(hex)	Read/Write
0	ID & version ID	Identifier	0X18	RO
1		Revision Compliance	0X30	RO
2		flate_men/CLEI/TWI max speed	*	RO
3		Module state/interrupt	*	RO
4	Bank lane Flag Summary	Bank 0 lane1~8 flag summary	*	RO
5		Bank 1 lane1~8 flag summary	*	RO
6		Bank 2 lane1~8 flag summary	*	RO
7		Bank 3 lane1~8 flag summary	*	RO
8	Module Flags	firmware fault & L-Module state change flage	*	RO
9		3.3V & temperture low/high alarm/warning flag	*	RO
10		L-Aux1 & L-Aux2 low/high alarm/warning flag	*	RO
11		L-Vendor define & L-Aux3 low/high alarm/warning flag	*	RO
12		reserved	00	RO
13		custom	00	RO

Data address	Name	Description	Value(hex)	Read/Write
14	Module Monitors	temperature1 MSB	*	RO
15		temperature1 LSB	*	RO
16		Supply 3.3 MSB	*	RO
17		Supply 3.3 LSB	*	RO
18		AUX 1 MSB	*	RO
19		AUX 1 LSB	*	RO
20		AUX 2 MSB	*	RO
21		AUX 2 LSB	*	RO
22		AUX 3 MSB	*	RO
23		AUX 3 LSB	*	RO
24		Custom MSB	*	RO
25		Custom LSB	*	RO
26	Module Global Con- trols	Squelch control / Force-LowPwr/soft reset	00	RW
27		reserved	00	RW
28				RW
29		Custom	00	RW
30				RW
31	Module masks	Mask bit for Module State Changed Flag	00	RW
32		Mask bit for temp&supply 3.3V low/high alarm/warning flag	00	RW
33		Mask bit for AUX1&AUX2 low/high alarm/warning flag	00	RW
34		Mask bit for AUX3&Vendor define low/high alarm/warning flag	00	RW
35		reserved	00	RW
36		Custom	00	RW
37-63	Reserved		00	RO
64-84	Custom		00	RW
85	Module Type Advertising code	Module Type Code	02	RO
86	Module Host-media interface Advertising options	Host Electrical Interface Code	11	RO
87		Module Media Interface Code	1D	RO
88		Host/Media LANE Count	84	RO
89		Host lane Assignment Options	01	RO
90		Host Electrical Interface Code	FF	RO
91		Module Media Interface Code	00	RO
92		Host/Media LANE Count	00	RO

Data address	Name	Description	Value(hex)	Read/Write
93		Host lane Assignment Options	00	RO
94		Host Electrical Interface Code	00	RO
95		Module Media Interface Code	00	RO
96		Host/Media LANE Count	00	RO
97		Host lane Assignment Options	00	RO
98		Host Electrical Interface Code	00	RO
99		Module Media Interface Code	00	RO
100		Host/Media LANE Count	00	RO
101		Host lane Assignment Options	00	RO
102		Host Electrical Interface Code	00	RO
103		Module Media Interface Code	00	RO
104		Host/Media LANE Count	00	RO
105		Host lane Assignment Options	00	RO
106		Host Electrical Interface Code	00	RO
107		Module Media Interface Code	00	RO
108		Host/Media LANE Count	00	RO
109		Host lane Assignment Options	00	RO
110		Host Electrical Interface Code	00	RO
111		Module Media Interface Code	00	RO
112		Host/Media LANE Count	00	RO
113		Host lane Assignment Options	00	RO
114		Host Electrical Interface Code	00	RO
115		Module Media Interface Code	00	RO
116		Host/Media LANE Count	00	RO
117		Host lane Assignment Options	00	RO
118-121	password Change Area		00	WO
122-125	Password Area		00	WO
126	Bank Select Byte		00	RW
127	Page Select Byte		00	RW

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Data address	Name	Description	Value(hex)	Read/Write
128	Identifier	ID	18	RO
129-144	Vendor name	Vendor name	*	RO
145-147	Vender OUI	Vendor Organizationally Unique ID	*	RO
148-163	Vender PN	Vender Part Number	*	RO

Data address	Name	Description	Value(hex)	Read/Write
164-165	Vender rev	Vender Revision Number	*	RO
166-181	Vender SN	Vender Serial Number	*	RO
182-183	Data Code	Data Code year	*	RO
184-185		Data Code month	*	RO
186-187		Data Code day of month	*	RO
188-189		Lot code	*	RO
190-199	CLEI Code	Common Language Equipment ID	*	RO
200	Module power characteristics	Module Power Class	A0	RO
201		Module MAX Power	30	RO
202	cable assembly length	cable assembly length	00	RO
203	Media Connector Type	Connector Type	07	RO
204	Copper Cable Attenuation	5G attenuation	00	RO
205		7G attenuation	00	RO
206		12.9G attenuation	00	RO
207		25.8G attenuation	00	RO
208-209		Reserved	00	RO
210	Cable Assembly Lane Information	near end implementation lane1~8	00	RO
211		Far end Configuration	00	RO
212	Media Interface Technology	wanlength&device	06	RO
213-220	Reserved		00	RO
221	Custom		00	RO
222	Checksum	Checksum for 128~221	*	RO
223-255	Custom Info NV		00	RO

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Data address	Name	Description	Value(hex)	Read/Write
128	Module FW&HW REV	Module firmware major revision	*	RO
129		Module firmware minor revision	*	RO
130		Module hardware major revision	*	RO
131		Module hardware minor revision	*	RO
132	Supported Link Length	Base Length (SMF)	14	RO
133		Length (OM5)	00	RO
134		Length (OM4)	00	RO
135		Length (OM3)	00	RO
136		Length (OM2)	00	RO
137		Reserved	00	RO

Data address	Name	Description	Value(hex)	Read/Write
138	Nominal Wavelength	wavelength MSB	65	RO
139		wavelength LSB	90	RO
140	Wavelength Tolerance	Wavelength Tolerance MSB	17	RO
141		Wavelength Tolerance LSB	70	RO
142	Implemengted manage- ment interface futures advertising	Diagnostic/page03/banks implemented	04	RO
143		ModSel wait time	f0	RO
144		DataPathDeinit/DataPathInit MaxDuration	88	RO
145	Module Characteristics advertising	Synchronous/Aux	80	RO
146		Maximum module temperature	46	RO
147		Minimum module temperature	00	RO
148		Propagation Delay MSB	00	RO
149		Propagation Delay LSB	00	RO
150		Minimum operating voltage	9c	RO
151		Rx Type	08	RO
152		per lane CDR Power saved	64	RO
153		Rx Output Amplitude code/Max Txeq	00	RO
154		Max Rx Out Eq Post/Pre-cursor	00	RO
155	Implemented Controls advertising	Tx Squelch/Disable/Polarity	02	RO
156		Rx Squelch/Disable/Polarity	00	RO
157	Imlemented Flags advertising	Tx Fault/Los/LoL Flag	01	RO
158		Rx Los/LoL Flag	02	RO
159	Implemented Monitors advertising	Monitor enable	0b	RO
160		Tx Bias current multiplier /Rx Power/Tx Power/Tx Bias enable	07	RO
161	Implemented Signal In- tegrity Controls advertising	TX EQ/CDR Control	00	RO
162		RX EQ/CDR Control	00	RO
163-175	Reserved		00	RO
176	Module Media Lane advertising	Media Lane Assignment Options, ApSel 0001b	01	RO
177		Media Lane Assignment Options, ApSel 0010b	00	RO
178		Media Lane Assignment Options, ApSel 0011b	00	RO
179		Media Lane Assignment Options, ApSel 0100b	00	RO
180		Media Lane Assignment Options, ApSel 0101b	00	RO
181		Media Lane Assignment Options, ApSel 0110b	00	RO
182		Media Lane Assignment Options, ApSel 0111b	00	RO
183		Media Lane Assignment Options, ApSel 1000b	00	RO

Data address	Name	Description	Value(hex)	Read/Write
184		Media Lane Assignment Options, ApSel 1001b	00	RO
185		Media Lane Assignment Options, ApSel 1010b	00	RO
186		Media Lane Assignment Options, ApSel 1011b	00	RO
187		Media Lane Assignment Options, ApSel 1100b	00	RO
188		Media Lane Assignment Options, ApSel 1101b	00	RO
189		Media Lane Assignment Options, ApSel 1110b	00	RO
190		Media Lane Assignment Options, ApSel 1111b	00	RO
191-222	Custom		00	RO
223	Extend Module Host- Media Interface Advertising options	HOST Electrical Interface Code	00	RO
224		Module Media Interface Code	00	RO
225		HOST /Media Lane Count	00	RO
226		HOST Lane Assignment Options	00	RO
227		HOST Electrical Interface Code	00	RO
228		Module Media Interface Code	00	RO
229		HOST /Media Lane Count	00	RO
230		HOST Lane Assignment Options	00	RO
231		HOST Electrical Interface Code	00	RO
232		Module Media Interface Code	00	RO
233		HOST /Media Lane Count	00	RO
234		HOST Lane Assignment Options	00	RO
235		HOST Electrical Interface Code	00	RO
236		Module Media Interface Code	00	RO
237		HOST /Media Lane Count	00	RO
238		HOST Lane Assignment Options	00	RO
239		HOST Electrical Interface Code	00	RO
240		Module Media Interface Code	00	RO
241		HOST /Media Lane Count	00	RO
242		HOST Lane Assignment Options	00	RO
243		HOST Electrical Interface Code	00	RO
244		Module Media Interface Code	00	RO
245		HOST /Media Lane Count	00	RO
246		HOST Lane Assignment Options	00	RO
247		HOST Electrical Interface Code	00	RO
248		Module Media Interface Code	00	RO
249		HOST /Media Lane Count	00	RO

Data address	Name	Description	Value(hex)	Read/Write
250		HOST Lane Assignment Options	00	RO
251-254	Rserved		00	RO
255	Checksum	130~254	*	RO

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Data address	Name	Description	Value(hex)	Read/Write
128	Module-Level monitor thresholds	Temperature monitor high alarm threshold MSB	50	RO
129		Temperature monitor high alarm threshold LSB	00	RO
130		Temperature monitor low alarm threshold MSB	f6	RO
131		Temperature monitor low alarm threshold LSB	00	RO
132		Temperature monitor high warning threshold MSB	46	RO
133		Temperature monitor high warning threshold LSB	00	RO
134		Temperature monitor low warning threshold MSB	00	RO
135		Temperature monitor low warning threshold LSB	00	RO
136		Supply 3.3-volt monitor high alarm threshold MSB	8d	RO
137		Supply 3.3-volt monitor high alarm threshold LSB	cc	RO
138		Supply 3.3-volt monitor low alarm threshold MSB	74	RO
139		Supply 3.3-volt monitor low alarm threshold LSB	04	RO
140		Supply 3.3-volt monitor high warning threshold MSB	87	RO
141		Supply 3.3-volt monitor high warning threshold LSB	5a	RO
142		Supply 3.3-volt monitor low warning threshold MSB	7a	RO
143		Supply 3.3-volt monitor low warning threshold LSB	76	RO
144		Aux 1 monitor high alarm threshold MSB	*	RO
145		Aux 1 monitor high alarm threshold LSB	*	RO
146		Aux 1 monitor low alarm threshold MSB	*	RO
147		Aux 1 monitor low alarm threshold LSB	*	RO
148		Aux 1 monitor high warning threshold MSB	*	RO
149		Aux 1 monitor high warning threshold LSB	*	RO
150		Aux 1 monitor low warning threshold MSB	*	RO
151		Aux 1 monitor low warning threshold LSB	*	RO
152		Aux 2 monitor high alarm threshold MSB	*	RO
153		Aux 2 monitor high alarm threshold LSB	*	RO
154		Aux 2 monitor low alarm threshold MSB	*	RO
155		Aux 2 monitor low alarm threshold LSB	*	RO
156		Aux 2 monitor high warning threshold MSB	*	RO
157		Aux 2 monitor high warning threshold LSB	*	RO

158		Aux 2 monitor low warning threshold MSB	*	RO
159		Aux 2 monitor low warning threshold LSB	*	RO
160		Aux 3 monitor high alarm threshold MSB	*	RO
161		Aux 3 monitor high alarm threshold LSB	*	RO
162		Aux 3 monitor low alarm threshold MSB	*	RO
163		Aux 3 monitor low alarm threshold LSB	*	RO
164		Aux 3 monitor high warning threshold MSB	*	RO
165		Aux 3 monitor high warning threshold LSB	*	RO
166		Aux 3 monitor low warning threshold MSB	*	RO
167		Aux 3 monitor low warning threshold LSB	*	RO
168		Custom monitor high alarm threshold MSB	*	RO
169		Custom monitor high alarm threshold LSB	*	RO
170		Custom monitor low alarm threshold MSB	*	RO
171		Custom monitor low alarm threshold LSB	*	RO
172		Custom monitor high warning threshold MSB	*	RO
173		Custom monitor high warning threshold LSB	*	RO
174		Custom monitor low warning threshold MSB	*	RO
175		Custom monitor low warning threshold LSB	*	RO
176		Tx optical power monitor high alarm threshold MSB	c3	RO
177		Tx optical power high alarm threshold LSB	c6	RO
178		Tx optical power low alarm threshold MSB	0a	RO
179		Tx optical power low alarm threshold LSB	0a	RO
180		Tx optical power high warning threshold MSB	62	RO
181		Tx optical power high warning threshold LSB	1e	RO
182		Tx optical power low warning threshold MSB	14	RO
183		Tx optical power low warning threshold LSB	08	RO
184	Lane-specific monitor thresholds	Tx bias current monitor high alarm threshold MSB	ff	RO
185		Tx bias current high alarm threshold LSB	ff	RO
186		Tx bias current low alarm threshold MSB	00	RO
187		Tx bias current low alarm threshold LSB	00	RO
188		Tx bias current high warning threshold MSB	ff	RO
189		Tx bias current high warning threshold LSB	ff	RO
190		Tx bias current low warning threshold MSB	00	RO
191		Tx bias current low warning threshold LSB	00	RO
192		Rx optical power monitor high alarm threshold MSB	c3	RO
193		Rx optical power high alarm threshold LSB	c6	RO
194		Rx optical power low alarm threshold MSB	03	RO

195		Rx optical power low alarm threshold LSB	90	RO
196		Rx optical power high warning threshold MSB	62	RO
197		Rx optical power high warning threshold LSB	1e	RO
198		Rx optical power low warning threshold MSB	07	RO
199		Rx optical power low warning threshold LSB	1b	RO
200-229	Reserved		00	RO
230-254	Customizable space		00	RO
255	Checksum	Covers bytes 128-254	*	RO

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Data address	Name	Description	Value(hex)	Read/Write
128	Data Path Power control	DataPathPwrUp lane1 ~ 8	00	RW
129	Lane-Specific Control	Tx1~8 Polarity Flip	00	RW
130		TX Disable for media lane 1~8	00	RW
131		TX Squelch for media lane 1~8	FF	RW
132		TX Force Squelch for media lane 1~8	00	RW
133		reserved	00	RO
134		TX Input Eq Adaptation Freeze for lane 1~8	00	RW
135		TX1~4 Input Eq Adaptation Store	00	WO
136		TX5~8 Input Eq Adaptation Store	00	WO
137		Rx1~8 Polarity Flip	00	RW
138		RX Output Disable for 1~8	00	RW
139		RX Squelch Disable for 1~8	00	RW
140		reserved	00	RO
141			00	
142			00	
143	Staged Control Set 0	Staged Set 0 Lane 1~8 Apply_DataPathInit	00	WO
144		Staged Set 0 Lane 1~8 Apply_Immediate	00	WO
145		Staged Set 0 Lane 1 Application code/Data Path code/Explicit Control	11	RW
146		Staged Set 0 Lane 2 Application code/Data Path code/Explicit Control	11	
147		Staged Set 0 Lane 3 Application code/Data Path code/Explicit Control	11	
148		Staged Set 0 Lane 4 Application code/Data Path code/Explicit Control	11	
149		Staged Set 0 Lane 5 Application code/Data Path code/Explicit Control	11	
150		Staged Set 0 Lane 6 Application code/Data Path code/Explicit Control	11	

Data address	Name	Description	Value(hex)	Read/Write
151		Staged Set 0 Lane 7 Application code/Data Path code/Explicit Control	11	
152		Staged Set 0 Lane 8 Application code/Data Path code/Explicit Control	11	
153		Staged Set 0 Tx1~8 Adaptive Input Eq Enable	FF	
154		Staged Set 0 Tx1~4 Adaptive Input Eq Recall	00	
155		Staged Set 0 Tx5~8 Adaptive Input Eq Recall	00	
156		Staged Set 0 Tx1~2 Input Eq control	00	
157		Staged Set 0 Tx3~4 Input Eq control	00	
158		Staged Set 0 Tx5~6 Input Eq control	00	
159		Staged Set 0 Tx7~8 Input Eq control	00	
160		Staged Set 0 Tx1~8 CDR control	FF	
161		Staged Set 0 Rx1~8 CDR control	FF	
162		Staged Set 0 Rx1~2 Output Eq control, pre-cursor	00	
163		Staged Set 0 Rx3~4 Output Eq control, pre-cursor	00	
164		Staged Set 0 Rx5~6 Output Eq control, pre-cursor	00	
165		Staged Set 0 Rx7~8 Output Eq control, pre-cursor	00	
166		Staged Set 0 Rx1~2 Output Eq control, post-cursor	00	
167		Staged Set 0 Rx3~4 Output Eq control, post-cursor	00	
168		Staged Set 0 Rx5~6 Output Eq control, post-cursor	00	
169		Staged Set 0 Rx7~8 Output Eq control, post-cursor	00	
170		Staged Set 0 Rx1~2 Output Amplitude control	*	
171		Staged Set 0 Rx3~4 Output Amplitude control	*	
172		Staged Set 0 Rx5~6 Output Amplitude control	*	
173		Staged Set 0 Rx7~8 Output Amplitude control	*	
174		reserved	00	RO
175			00	
176			00	
177			00	
178	Staged Control Set 1	Staged Set 1 Lane 1~8 Apply_DataPathInit	00	WO
179		Staged Set 1 Lane 1~8 Apply_Immediate	00	WO
180		Staged Set 1 Lane 1 Application code/Data Path code/Explicit Control	00	RW

Data address	Name	Description	Value(hex)	Read/Write
181		Staged Set 1 Lane 2 Application code/Data Path code/Explicit Control	00	
182		Staged Set 1 Lane 3 Application code/Data Path code/Explicit Control	00	
183		Staged Set 1 Lane 4 Application code/Data Path code/Explicit Control	00	
184		Staged Set 1 Lane 5 Application code/Data Path code/Explicit Control	00	
185		Staged Set 1 Lane 6 Application code/Data Path code/Explicit Control	00	
186		Staged Set 1 Lane 7 Application code/Data Path code/Explicit Control	00	
187		Staged Set 1 Lane 8 Application code/Data Path code/Explicit Control	00	
188		Staged Set 1 Tx1~8 Adaptive Input Eq Enable	00	
189		Staged Set 1 Tx1~4 Adaptive Input Eq Recall	00	
190		Staged Set 1 Tx5~8 Adaptive Input Eq Recall	00	
191		Staged Set 1 Tx1~2 Input Eq control	00	
192		Staged Set 1 Tx3~4 Input Eq control	00	
193		Staged Set 1 Tx5~6 Input Eq control	00	
194		Staged Set 1 Tx7~8 Input Eq control	00	
195		Staged Set 1 Tx1~8 CDR control	00	
196		Staged Set 1 Rx1~8 CDR control	00	
197		Staged Set 1 Rx1~2 Output Eq control, pre-cursor	00	
198		Staged Set 1 Rx3~4 Output Eq control, pre-cursor	00	
199		Staged Set 1 Rx5~6 Output Eq control, pre-cursor	00	
200		Staged Set 1 Rx7~8 Output Eq control, pre-cursor	00	
201		Staged Set 1 Rx1~2 Output Eq control, post-cursor	00	
202		Staged Set 1 Rx3~4 Output Eq control, post-cursor	00	
203		Staged Set 1 Rx5~6 Output Eq control, post-cursor	00	
204		Staged Set 1 Rx7~8 Output Eq control, post-cursor	00	
205		Staged Set 1 Rx1~2 Output Amplitude control	00	
206		Staged Set 1 Rx3~4 Output Amplitude control	00	
207		Staged Set 1 Rx5~6 Output Amplitude control	00	
208		Staged Set 1 Rx7~8 Output Amplitude control	00	

Data address	Name	Description	Value(hex)	Read/Write
209		reserved	00	RO
210				
211				
212				
213	Lane-Specific Flag Masks	M-Lane 1~8 Data Path State Changed flag mask	00	RW
214		M-Tx1~8 Fault flag mask	00	RW
215		M-Tx1~8 LOS flag mask	00	RW
216		M-Tx1~8 CDR LOL flag mask	00	RW
217		M-Tx1~8 Adaptive Eq Fault flag mask	00	RW
218		M-Tx1~8 Power High Alarm flag mask	00	RW
219		M-Tx1~8 Power Low Alarm flag mask	00	RW
220		M-Tx1~8 Power High Warning flag mask	00	RW
221		Tx1~8 Power Low Warning flag mask	00	RW
222		M-Tx1~8 Bias High Alarm flag mask	00	RW
223		M-Tx1~8 Bias Low Alarm flag mask	00	RW
224		M-Tx1~8 Bias High Warning flag mask	00	RW
225		M-Tx1~8 Bias Low Warning flag mask	00	RW
226		M-Rx1~8 LOS flag mask	00	RW
227		M-Rx1~8 CDR LOL flag mask	00	RW
228		M-Rx1~8 Power High Alarm flag mask	00	RW
229		M-Rx1~8 Power Low Alarm flag mask	00	RW
230		M-Rx1~8 Power High Warning flag mask	00	RW
231		M-Rx1~8 Power Low Warning flag mask	00	RW
232-239	Reserved		00	RO
240-255	Custom		00	RO

Upper Memory Map Page 11h

Data address	Name	Description	Value(hex)	Read/Write
128	Datapath State indicators	Data path state encoding for lane1~2	*	RO
129		Data path state encoding for lane3~4	*	RO
130		Data path state encoding for lane5~6	*	RO
131		Data path state encoding for lane7~8	*	RO
132-133	reserved		00	RO
134	Lane-specific flags	Latched Data Path State Changed flag for lane 1~8	*	RO
135		Latched Tx Fault flag, media lane1~8	*	RO

Data address	Name	Description	Value(hex)	Read/Write
136		Latched Tx LOS flag, lane 1~8	*	RO
137		Latched Tx CDR LOL flag, lane1~8	*	RO
138		Latched Tx Adaptive Input Eq.Fault Lane 1~8	*	RO
139		Tx output power High Alarm, media lane 1~8	*	RO
140		Tx output power Low alarm, media lane 1~8	*	RO
141		Tx output power High warning, media lane 1~8	*	RO
142		Tx output power High warning, media lane 1~8	*	RO
143		Tx Bias High Alarm, media lane1~8	*	RO
144		Tx Bias Low alarm, media lane1~8	*	RO
145		Tx Bias High warning, media lane1~8	*	RO
146		Tx Bias Low warning, media lane1~8	*	RO
147		Latched Rx LOS flag, media lane1~8	*	RO
148		Latched Rx CDR LOL flag, media lane 1~8	*	RO
149		Rx input power High alarm, media lane 1~8	*	RO
150		Rx input power Low alarm, media lane 1~8	*	RO
151		Rx input power High warning, media lane 1~8	*	RO
152		Rx input power Low warning, media lane 1~8	*	RO
153	reserved		00	RO
154		Tx1 Power MSB	*	RO
155		Tx1 Power LSB	*	RO
156		Tx2 Power MSB	*	RO
157		Tx2 Power LSB	*	RO
158		Tx3 Power MSB	*	RO
159		Tx3 Power LSB	*	RO
160		Tx4 Power MSB	*	RO
161		Tx4 Power LSB	*	RO
162	Lane-specific monitors	Tx5 Power MSB	*	RO
163		Tx5 Power LSB	*	RO
164		Tx6 Power MSB	*	RO
165		Tx6 Power LSB	*	RO
166		Tx7 Power MSB	*	RO
167		Tx7 Power LSB	*	RO
168		Tx8 Power MSB	*	RO
169		Tx8 Power LSB	*	RO
170		Tx1 Bias MSB	*	RO
171		Tx1 Bias LSB	*	RO

Data address	Name	Description	Value(hex)	Read/Write
172		Tx2 Bias MSB	*	RO
173		Tx2 Bias LSB	*	RO
174		Tx3 Bias MSB	*	RO
175		Tx3 Bias LSB	*	RO
176		Tx4 Bias MSB	*	RO
177		Tx4 Bias LSB	*	RO
178		Tx5 Bias MSB	*	RO
179		Tx5 Bias LSB	*	RO
180		Tx6 Bias MSB	*	RO
181		Tx6 Bias LSB	*	RO
182		Tx7 Bias MSB	*	RO
183		Tx7 Bias LSB	*	RO
184		Tx8 Bias MSB	*	RO
185		Tx8 Bias LSB	*	RO
186		Rx1 Power MSB	*	RO
187		Rx1 Power LSB	*	RO
188		Rx2 Power MSB	*	RO
189		Rx2 Power LSB	*	RO
190		Rx3 Power MSB	*	RO
191		Rx3 Power LSB	*	RO
192		Rx4 Power MSB	*	RO
193		Rx4 Power LSB	*	RO
194		Rx5 Power MSB	*	RO
195		Rx5 Power LSB	*	RO
196		Rx6 Power MSB	*	RO
197		Rx6 Power LSB	*	RO
198		Rx7 Power MSB	*	RO
199		Rx7 Power LSB	*	RO
200		Rx8 Power MSB	*	RO
201		Rx8 Power LSB	*	RO
202	Configuration Error Codes	Configuration Error Code for lane1~2	*	RO
203		Configuration Error Code for lane3~4	*	RO
204		Configuration Error Code for lane5~6	*	RO
205		Configuration Error Code for lane7~8	*	RO
206	Active Control Set	Active Set Lane 1 Application code/Data Path code/Explicit Control	*	RO

Data address	Name	Description	Value(hex)	Read/Write
207		Active Set Lane 2 Application code/Data Path code/Explicit Control	*	RO
208		Active Set Lane 3 Application code/Data Path code/Explicit Control	*	RO
209		Active Set Lane 4 Application code/Data Path code/Explicit Control	*	RO
210		Active Set Lane 5 Application code/Data Path code/Explicit Control	*	RO
211		Active Set Lane 6 Application code/Data Path code/Explicit Control	*	RO
212		Active Set Lane 7 Application code/Data Path code/Explicit Control	*	RO
213		Active Set Lane 8 Application code/Data Path code/Explicit Control	*	RO
214		Active Set Tx1~8 Adaptive Input Eq Enable	*	RO
215		Active Set Tx1~4 Adaptive Input Eq Recall	*	RO
216		Active Set Tx5~8 Adaptive Input Eq Recall	*	RO
217		Active Set Tx1~2 Input Eq control	*	RO
218		Active Set Tx3~4 Input Eq control	*	RO
219		Active Set Tx5~6 Input Eq control	*	RO
220		Active Set Tx7~8 Input Eq control	*	RO
221		Active Set Tx1~8 CDR control	*	RO
222		Active Set Rx1~8 CDR control	*	RO
223		Active Set Rx1~2 Output Eq control, pre-cursor	00	RO
224		Active Set Rx3~4 Output Eq control, pre-cursor	00	RO
225		Active Set Rx5~6 Output Eq control, pre-cursor	00	RO
226		Active Set Rx7~8 Output Eq control, pre-cursor	00	RO
227		Active Set Rx1~2 Output Eq control, post-cursor	00	RO
228		Active Set Rx3~4 Output Eq control, post-cursor	00	RO
229		Active Set Rx5~6 Output Eq control, post-cursor	00	RO
230		Active Set Rx7~8 Output Eq control, post-cursor	00	RO
231		Active Set Rx1~2 Output Amplitude control	*	RO
232		Active Set Rx3~4 Output Amplitude control	*	RO
233		Active Set Rx5~6 Output Amplitude control	*	RO
234		Active Set Rx7~8 Output Amplitude control	*	RO
235-239	reserved		00	RO
240	Host Electrical to Module Media Lane Map- ping	Module TX media lane 1 wave-length/fiber mapping	*	RO
241		Module TX media lane 2 wave-length/fiber mapping	*	RO
242		Module TX media lane 3 wave-length/fiber mapping	*	RO

Data address	Name	Description	Value(hex)	Read/Write
243		Module TX media lane 4 wave-length/fiber mapping	*	RO
244		Module TX media lane 5 wave-length/fiber mapping	*	RO
245		Module TX media lane 6 wave-length/fiber mapping	*	RO
246		Module TX media lane 7 wave-length/fiber mapping	*	RO
247		Module TX media lane 8 wave-length/fiber mapping	*	RO
248		Module RX media lane 1 wave-length/fiber mapping	*	RO
249		Module RX media lane 2 wave-length/fiber mapping	*	RO
250		Module RX media lane 3 wave-length/fiber mapping	*	RO
251		Module RX media lane 4 wave-length/fiber mapping	*	RO
252		Module RX media lane 5 wave-length/fiber mapping	*	RO
253		Module RX media lane 6 wave-length/fiber mapping	*	RO
254		Module RX media lane 7 wave-length/fiber mapping	*	RO
255		Module RX media lane 8 wave-length/fiber mapping	*	RO

Digital Diagnostic Monitoring Functions

FST-100G-DR support the I^2C-based Diagnostic Monitoring Interface (DMI) defined in document SFF-8636. The host can access real-time performance of transmitter and receiver optical power, temperature, supply voltage and bias current.

Performance Item	Related Bytes(A0[00] memory)	Monitor Error	Notes
Module temperature	22 to 23	+/-3℃	1，2
Module voltage	26 to 27	< 3%	2
LD Bias current	42 to 43	< 10%	2
Transmitter optical power	50 to 51	< 3dB	2
Receiver optical power	34 to 35	< 3dB	2

Note

1. Actual temperature test point is fixed on module case around Laser.
2. Full operating temperature range

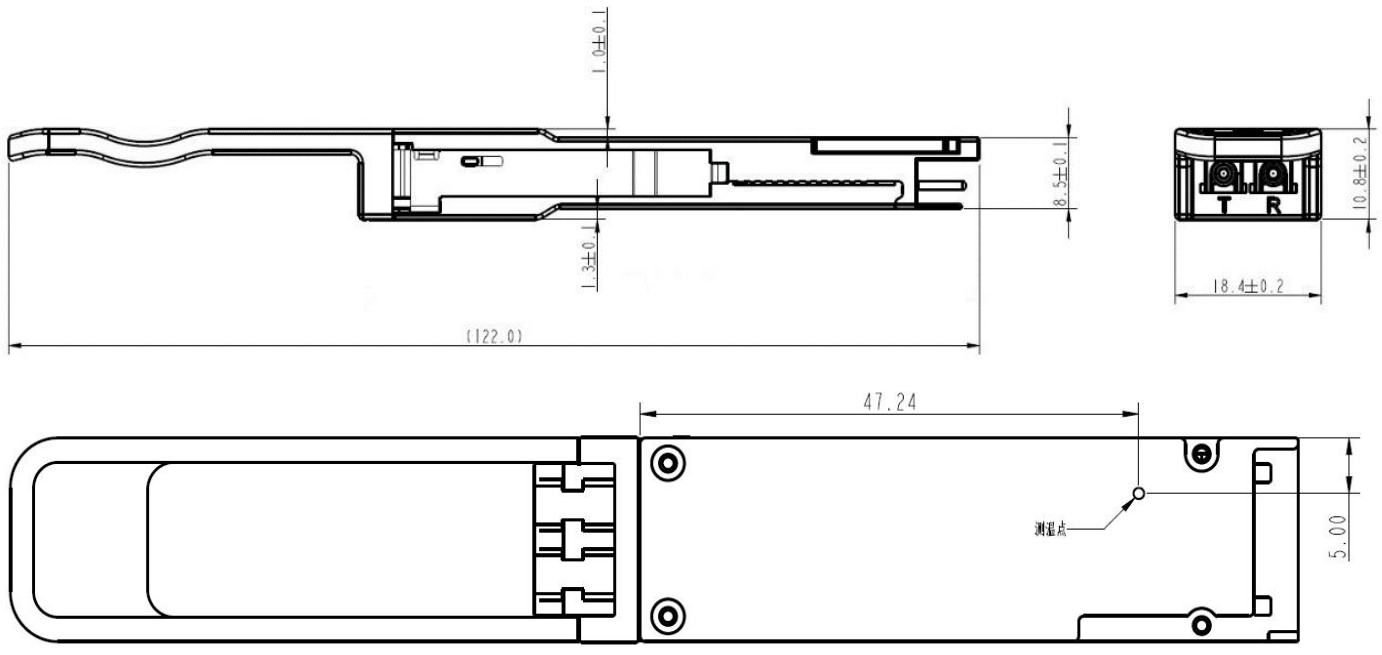
Alarm and Warning Thresholds

FST-100G-DR support alarms function, indicating the values of the preceding basic performance are lower or higher than the thresholds.

Performance Item	Alarm Threshold Bytes(A0[03] memory)	Unit	Low threshold	High threshold
Temp Alarm	128 to 131	℃	-10	80
Temp Warning	132 to 135	℃	0	70
Voltage Alarm	144 to 147	V	2.97	3.63
Voltage Warning	148 to 151	V	3.135	3.465
TX Power Alarm	192 to 195	dBm	-6.3	6.5
TX Power Warning	196 to 199	dBm	-3.3	3.5
RX Power Alarm	176 to 179	dBm	-10.6	6.5

RX Power Warning	180 to 183	dBm	-7.6	3.5

Mechanical Specifications



Regulatory Compliance

FST-100G-DR Optical Transceiver is RoHS 6/6 compliant and complies with international electromagnetic compatibility (EMC) and product safety requirements and standards

Feature	Standard	Performance
Safety		
UL	UL 62368-1	UL recognized component for US and CAN
	CAN/CSA C22.2 No. 62368-1-14	
TUV	EN 60950-1	TUV certificate
	EN/IEC 60825-1:2007,Edition 2	
	EN/IEC 60825-1:2014,Edition 3	
	EN/IEC 60825- 2:2004+A1:2006+A2:2010	
FDA	U.S. 21 CFR 1040.10	FDA/CDRH certified with accession number according to Laser Notice 50
Electromagnetic Compatibility		
Radiated emissions	EMC Directive 2014/30/EU	Class B digital device with a minimum -6dB margin to the limit when tested with a metal enclosure. Final margin may vary depending on system application, good system EMI design practice, ie: suitable metal enclosure and well-bonding, is required to achieve Class B margins at the system level.Tested frequency range: 30 MHz to 40 GHz or 5th harmonic (5 times the highest frequency), whichever is less.
	EN 55032	
	CISPR 32	
	FCC rules 47 CFR Part 15	
	ICES-003	
	AS/NZS CISPR 32	
ESD	EN 55024	Withstands discharges of ± 8 k V contact, ±15 k V air.
	CISPR 24	
	IEC/EN 61000-4-2	
Radiated immunity	EN 55024	Field strength of 10 V/m from 80 MHz to 6 GHz.
	CISPR 24	
	IEC/EN 61000-4-3	

Feature	Standard	Performance
Restriction of Hazardous Substances		
RoHS	EU Directive 2011/65/EU (EU) 2015/863	

ESD Design

Normal ESD precautions are required during the handling of this module. This transceiver is shipped in ESD protective packaging. It should be removed from the packaging and otherwise handled in an ESD protected environment utilizing standard grounded benches, floor mats, and wrist straps.

Parameter	Threshold value	Notes
ESD of high-speed pins	1KV	Human Body Model
ESD of low-speed pins	2KV	Human Body Model
Air discharge during operation	15KV	
Direct contact discharges to the case	8KV	

Safety Specification Design

Do not look into fiber end faces without eye protection using an optical meter (such as magnifier and microscope) within 100 mm, unless you ensure that the laser output is disabled.

When operating an optical meter, observe the operation requirements.

CAUTION: Use of controls or adjustments or performance of procedures other than those

specified herein may result in hazardous radiation exposure.

Part Number	Description
FST-100G-FR	QSFP28 100GBASE-FR 1310nm 2km SMF LC Optical Transceiver Module